Managing Diabetes in Long-Term Care Facilities: Benefits of Switching from Human Insulin to Insulin Analogs

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The unique requirements of residents with diabetes in long-term care (LTC) facilities necessitate a protocol-driven, individualized approach to care. Established treatment guidelines for the management of diabetes are written with the general population in mind and, although the principles remain the same in LTC patients, clinical priorities and strategies may need to be modified, and glycemic goals should be balanced against quality of life. This article identifies and explores the institutional, staff, patient and medication-related factors that contribute to the complexity of delivering optimal diabetes care in the LTC setting, and focuses on how insulin analogs, and the pens used for their delivery, can simplify and improve care delivery while, in many cases, reducing institutional costs. **(J Am Med Dir Assoc 2009; ■: ■–■)**

Keywords: Long-term care (LTC); insulin analogs; insulin pens; cost

The prevalence of diabetes is high and increasing in older adults, many of whom are cared for in long-term care (LTC) residences such as nursing homes and assisted living facilities. In 2007, 23.1% of people aged 60 or older, or 12.2 million people, and about 25% of nursing home residents,[1,2] fulfilled the diagnostic criteria for diabetes, most with type 2 disease.[3] Because many patients in LTC facilities have diabetes-related complications secondary to accelerated microvascular and macrovascular disease (Table 1)[4] as well as other comorbidities requiring multiple medications, effective diabetes management is complex and requires a protocol-driven, team-based, individualized approach to care.

It is now widely accepted that intensive control of blood glucose that maintains HbA1c to lower than 7%, as recommended by the American Diabetes Association (ADA)[5] or even as low as 6.5% or less, can reduce microvascular complications,[6–9] and may reduce cardiovascular disease.[7,8,10–12] As such, there are persuasive health-related and economic reasons for treatment approaches that achieve these targets in the population as a whole. However, the recently reported long-term ADVANCE and Veterans Affairs Diabetes Trials, in patients with type 2 diabetes and increased cardiovascular risk, demonstrated no cardiovascular benefit to intensive glycemic control, whereas the ACCORD study, undertaken in a similar population, was terminated early after concluding that intensive treatment to achieve near-normal glycemic control was associated with increased mortality in this high-risk population.[13] Although researchers remain unsure as to the precise mechanisms underlying the results from ACCORD, the findings support a slightly more prudent approach that brings HbA1c toward ADA target levels in high-risk adults, without the need to treat unduly aggressively. Indeed, a recent joint position statement issued by the ADA in conjunction with the American College of Cardiology Foundation and the American Heart Association in relation to ACCORD, ADVANCE, and the VA Diabetes Trial, stressed the need for an individualized approach to treatment, and less stringent HbA1c targets in patients with limited life expectancy, advanced microvascular or macrovascular complications, extensive comorbid conditions, or those with longstanding diabetes in whom the A1c goal is difficult to attain.[14] As such, although the principles of diabetes management are the same in older as in younger adults, national targets may not be appropriate for all LTC residents[5,15,16]; clinical priorities and strategies must be tailored to the individual and glycemic goals balanced against quality of life and relaxed in some patients. These caveats notwithstanding, the benefits of good glycemic control in older adults, including reduced incidence and progression of chronic complications, improved cognitive function, fewer infections, reduced incontinence, fewer emergency room visits, greater overall well-being and possibly reduced mortality rate,[17,18] would support a proactive approach.

The aim of this review was to identify and discuss the institutional, staff, patient, and medication-related factors that contribute to the complexity of delivering optimal diabetes care in the LTC setting, and to offer guidance on how insulin analogs, and the pens used for their delivery, can facilitate improved care delivery, while in many cases reducing institutional costs.

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Table 1. *Complications Associated with Diabetes in the Elderly*[4]

Confusion, acceleration of cognitive impairment
Decline in ability to perform activities of daily living
Dehydration
Depression
Excessive skin problems (infection, ulcers, delayed wound healing)
Eye problems (visual blurring, visual loss)
Falls
Foot ulcers, foot deformities, gangrene
Frequent infections
Increased pain perception, neuropathy
Nonketotic hyperosmolar coma
Oral health problems (caries, periodontal disease, tooth loss, dry mouth, burning mouth)
Recent change in weight (gain or loss)
Stroke
Urinary frequency, nocturia, urinary incontinence
Worsening cardiac ischemia, silent ischemia

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DIABETES MANAGEMENT IN THE LONG-TERM CARE SETTING

The recommended model of care for adults with diabetes in the LTC setting is summarized in the clinical practice guideline, "Diabetes management in the long-term care setting," published by the American Medical Directors Association (AMDA).[4] In addition to providing a stepwise diagnostic and treatment algorithm, the guideline emphasizes the need for a systematic, interdisciplinary team-based approach to care, the use of outcome and process indicators to measure a facility's performance in diabetes management, and continued monitoring of patients.

Although it is recognized that lifestyle changes may not always be possible, the consensus opinion of several key organizations (ADA, AMDA, and American Dietetic Association)[3,4,19] is that residents should be offered a regular diet, physical activity should be encouraged to the extent possible, and initial management of diabetes should include pharmacological treatment with oral antidiabetic agents (OADs), and metformin in particular. When an initial OAD fails, combination therapy using a selection of agents with different mechanisms of action is recommended, but once OADs alone are unable to achieve individual glycemic goals, insulin may be indicated. Timely initiation of insulin helps bring glucose levels toward target, mitigating the hyperglycemia brought on by progressive beta cell exhaustion and glucotoxicity, and slowing development of diabetes-related complications. Insulin can also improve overall well-being in residents with poor glycemic control and weight loss (in whom it typically increases weight by 4–5 kg), and in patients whose primary symptoms are those resulting from chronic hyperglycemia.[20] The use of insulins and insulin delivery devices that provide effective glycemic control while simplifying administration, and ensuring staff and patient safety, can be of particular value in LTC patients, because of the specific needs of this population.

CHALLENGES OF MANAGING DIABETES IN OLDER ADULTS

Disease-Specific Factors

Multiple diabetic complications and age-related changes in metabolic processes affect drug pharmacokinetics and pharmacodynamics, thereby increasing the difficulty of managing diabetes in LTC residents, in whom the potential for, and dangers of, hypoglycemia are greater.[21,22] Predicting the timing of peak insulin action is a significant challenge and, furthermore, hypoglycemia is more difficult to detect in those with autonomic neuropathy or cognitive deficits such as dementia, and may present in a different way than in younger patients.[23] Visual and cognitive impairment, anxiety and depression, reduced manual dexterity, and irregular meal consumption common in older patients with diabetes, as well as the challenge of complex or awkward delivery systems, further increase the difficulty of self-administering and adhering to treatment in the minority of patients who choose to self-administer insulin, particularly in the assisted living setting. HbA1c goals, medications, and mode of administration must therefore be tailored to the individual, and balanced against hypoglycemic risk and overall quality of life.[13]

Institutional Factors

The operational circumstances of many LTC facilities may themselves increase the difficulty of caring for patients with diabetes. Staff shortages, frequent staff turnover, and poor compensation make hiring and retaining qualified staff difficult. In the authors' experience, outdated practices, including the persistence of "diabetic" or "no concentrated sweet" diets, no longer recommended by national organizations,[4] remain in many institutions. Similarly, glucose logs are not reviewed in sufficient detail or with the necessary frequency to implement logical changes to insulin or OAD regimens.[24] In the authors' opinion, there is often excessive reliance on HbA1c, or on isolated fasting glucose levels for assessing metabolic control. Further to this, there is frequently variance in provider estimates of appropriate HbA1c targets, even for practitioners working in the same institution. For example, in a year-long physician and nurse practitioner (n = 18 total) survey of care delivery practices in a nursing facility of an urban teaching hospital, 56% of providers expressed the opinion that a target HbA1c of 7% was appropriate for LTC residents, whereas 22% identified 8% and another 22% gave 9% as the appropriate target.[25] It is also noteworthy that many facilities do not test postprandial glucose (PPG) level, known to be an independent risk factor for cardiovascular events,[26] possibly exposing patients to unnecessary additional cardiovascular risk. When using insulin, infrequent rotation of injection sites, and improper timing of insulin to meals, can all contribute to suboptimal care.

Staff Factors

Owing to inadequate educational opportunities and time constraints, nurses and ancillary staff may have outdated or insufficient knowledge of diabetes,[24] resulting in

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inappropriate dosing or timing of insulin injections. Breakdown in team communication, and inadequate protocols that do not require nursing staff to alert physicians to persistently elevated blood glucose levels or marked glucose excursions, deny patients the opportunity for timely improvement in glycemic control. Similarly, when physicians make treatment decisions based on HbA1c alone, without examining glucose logs, and when their familiarity and comfort with newer treatment, and with initiating and intensifying insulin is limited, adherence to evidence-based algorithms is unlikely. An attitude of "therapeutic nihilism," in which optimizing glucose control is deemed pointless, or not worth the trouble, is not uncommon when treating older and impaired patients, and risks creating an environment in which suboptimal care continues unchallenged. Indeed, even in the absence of therapeutic nihilism, experienced nursing home physicians manage diabetes less aggressively in patients who are both cognitively and functionally impaired than in those who are either functionally or cognitively impaired. This was demonstrated in a survey that reported responses from 255 nursing home physicians with varying levels of experience and training; survey results showed a significantly reduced frequency of routine monitoring (eg, HbA1c, basic chemistry) and interventions (eg, routine ophthalmology examinations) in cognitively and functionally impaired individuals, although the investigators did not examine the reasons for the different management strategies.[27] The results may reflect physician adherence to guidelines that recommend individualization of care in this patient group or, alternatively, may indicate a perceived lack of benefit, and/or concern about greater patient inconvenience, when more intensive treatment is used in impaired patients.

Medication and Drug Delivery Factors

There remain a number of practices that, although outdated, continue to be used in some LTC facilities. These include the persistence of now discredited sliding scale insulin protocols,[28] without scheduled mealtime insulin or rational adjustment to regimens,[29] the tendency to use "one size fits all" regimens, and the continued reliance on human insulin, delivered using vial and syringe, despite compelling data supporting the advantages of insulin analogs delivered using insulin pens. This is discussed in detail later in this paper.

Patient Factors

Despite health care provider recommendation, patients may be reluctant to start insulin, or to accept multiple daily doses. Reasons for this "psychological insulin resistance" in the general adult population are discussed at length elsewhere[30–32] and may include feelings of defeat or personal failure regarding disease management, fear of hypoglycemia or weight gain, needle anxiety, and concern about being able to cope with what seems a complicated new treatment. Although there are no studies addressing this issue specifically in the elderly, clinical experience suggests that concerns about adverse effects and the difficulties of starting a new and potentially complex treatment late in life would predominate. LTC subjects who do start insulin may be frustrated in their efforts by complications resulting from their diabetes and/or concurrent disease processes; for example, fasting hypoglycemia followed by very high blood glucose levels later in the day may combine to make treatment feel overwhelming. The greater potential for adverse effects and drug interactions in elderly patients necessitate caution when prescribing, and greater vigilance in monitoring adverse effects, particularly since hepatic and renal impairment are relatively common in older residents with diabetes.

"State of the Field" Factors

The lack of studies evaluating optimal glycemic and HbA1C goals, as well as lipid and blood pressure targets, in elders and nursing home patients leaves health care providers with little evidence-based guidance.[33] Likewise, there is often insufficient attention to evidence that indicates practices to be avoided.[33] Individual facilities frequently lack protocols for monitoring diabetes or assessing facility-wide diabetes management, resulting in inconsistencies in treatment and different approaches to management even within institutions. Health care providers are therefore urged to consult guidelines designed with the long-term patient population in mind, all of which have been prepared by expert consensus and analysis of available evidence. These include the AMDA clinical practice guidelines[4] as well as those from the American Geriatrics Society in collaboration with the California Healthcare Foundation,[16] and those by Zarowitz et al.[34]

THE ECONOMIC BENEFITS OF OPTIMIZING GLYCEMIC CONTROL

In addition to improving patient well-being and prognosis, there are compelling economic reasons to strive for optimal glycemic control, and particularly for reduction of chronic complications. The estimated cost of diabetes in the United States in 2007 was $174 billion, of which $58 billion was used to treat chronic complications.[35] In a 2002 retrospective database analysis of more than 3000 health maintenance organization claims, patients with type 2 diabetes whose HbA1c was consistently greater than 7% over 1 year accrued diabetes-related costs 32% higher than those whose HbA1c remained 7% or lower ($1540 versus $1171),[36] whereas a retrospective US-based analysis of more than 9000 commercial health plan claims in 2006, found that 12-month costs for patients with diabetes and macrovascular disease were more than 3 times those with diabetes but no macrovascular disease ($10,450 versus $3,385).[37] Similarly, a large European study (CODE -2), found that the presence of both microvascular and macrovascular disease increased the total cost of management by as much as 250% per patient.[38] A systematic review evaluating economic and resource utilization in US-managed care organizations found that pharmacy costs were primarily driven by medications used to treat diabetic complications, with only 30% expended on glycemic control.[39] In this study, improving and maintaining glycemic control led to overall cost savings, irrespective of the medications used. Interestingly, the higher initial pharmacy costs associated with starting insulin or using

newer, more expensive, insulin formulations were more than offset by reduced inpatient hospital admissions, sometimes within less than 1 year.

Although data are lacking on the cost of complications specifically in the LTC setting, it is clear that they significantly increase the cost of care. Strategies to guide the safe attainment of glycemic control not only ensure high standards of patient care but also contain costs by forestalling the development of, or worsening of, chronic diabetic complications, reducing the incidence of hypoglycemic events, reducing needlestick injuries to staff and patients, and by limiting the frequency of hospitalization and emergency room visits.

INSULIN ANALOGS AND DELIVERY PENS CAN IMPROVE PATIENT CARE AND REDUCE INSTITUTIONAL COSTS

Clinical Benefits of Insulin Analogs

Insulin analogs, developed by making minor amino acid substitutions to the human insulin molecule, have pharmacokinetic and pharmacodynamic profiles that closely approximate those of endogenous insulin, resulting in a more consistent glycemic effect than human insulins; similar, or even lower, HbA1c; better control of postprandial and fasting glucose; and reduced rates of hypoglycemia, particularly at night (Table 2).[40] Retail prescriptions for insulin analogs among nonhospitalized patients now far exceed those for human insulins (approximately 48,000 versus 19,000 units $\times 10^6$ in 2007), but LTC formularies generally do not reflect this preference: 2007 data for prescriptions in LTC facilities indicate comparable prescription data of 3100 and 3500 units $\times 10^6$ for insulin analogs and human insulins, respectively (IMS Health; data on file 2007).

Data on basal insulins, usually the first choice for once-daily treatment, demonstrate several advantages for analogs, particularly a reduced incidence of hypoglycemia. In a meta-analysis comparing insulin detemir (2 studies, 578 patients) and insulin glargine (6 studies, 1715 patients) with neutral protamine Hagedorn (NPH) insulin, in studies of 24 to 52 weeks' duration, patients were found to have a similar degree of metabolic control, using HbA1c as a surrogate end point, as well as similar rates of severe hypoglycemia and overall adverse events, but the incidences of overall, symptomatic, and nocturnal hypoglycemia were all statistically significantly reduced in the insulin analog groups.[41] Similarly, a systematic review of 6 head-to-head insulin glargine versus NPH studies found equivalence with respect to reduction in HbA1c, but patients receiving glargine experienced equivalent or lower fasting plasma glucose (FPG) levels and less frequent nocturnal hypoglycemia.[42] Additional data suggest that this reduction in nocturnal hypoglycemia holds true only during once-daily administration of NPH; during twice-daily dosing, the superiority of glargine may no longer be apparent.[43]

Individual trial data highlight some of the advantages of basal insulin analogs in patients with type 2 diabetes. In a 2-week treat-to-target study of 498 insulin-naïve type 2 patients poorly controlled on OADs, patients taking once-daily insulin detemir in the evening experienced reductions in 24-hour and nocturnal hypoglycemia that were 53% ($P = .02$) and 63% ($P = .03$) lower, respectively, than those in patients taking evening NPH insulin.[44] When insulin detemir was given in the morning, the incidence of nocturnal hypoglycemia fell by 87% compared with that observed in patients taking evening NPH insulin ($P < .001$). Similarly, addition of insulin glargine to failing OADs in a group of 756 overweight individuals allowed approximately 60% to reach HbA1c 7.0% or less, with significantly fewer patients on glargine experiencing nocturnal hypoglycemia (33% versus 27%, $P < .05$).[45] In a post hoc analysis of 3 open-label multinational phase III studies in which older (≥ 65 years) and younger (18–64 years) individuals with type 2 diabetes were treated for 22 to 26 weeks with basal insulin (NPH insulin or insulin detemir) plus mealtime insulin or OADs, control of HbA1c and FPG were equivalent in the 416 older adults receiving insulin detemir or NPH insulin, but the relative risk of hypoglycemia favored insulin detemir (RR = 0.59), as did the reduced weight gain (mean treatment difference –1.02 kg).[46] When choosing an initial insulin regimen in type 2 patients inadequately controlled on OADs, studies show that the addition of a basal analog to OADs offers greater efficacy with less hypoglycemia than starting twice-daily human premix without OADs; this was true for both the general adult population[47] and for older adults.[48]

Observational study results are a valuable addition to clinical trial data in that they typically reflect real-life practice and outcomes. The very large Predictable Results and Experience in Diabetes through Intensification and Control to Target: an International Variability Evaluation (PREDICTIVE) trial, a multinational, prospective, observational study of insulin detemir in clinical practice, demonstrated the ability of insulin detemir, with or without OADs, to significantly reduce mean HbA1c (–1.3%; $P < .0001$) and fasting glucose (–3.7 mmol/L; $P < .0001$), typically with once-daily injection.[49] There was a significantly reduced risk of hypoglycemia in patients who switched to insulin detemir from NPH insulin as well as in those starting insulin detemir after OAD failure.[50] PREDICTIVE also highlighted the weight-sparing effect of insulin detemir.[50] Similarly, in a retrospective observational study in 397 patients with type 2 diabetes who switched from an

Table 2. *Advantages of Insulin Analogs over Human Insulin in the Long-Term Care Setting*

More consistent, predictable glycemic effect
Equivalent or lower HbA1c
Better control of fasting and postprandial glucose levels
Reduced risk of hypoglycemia, particularly at night
Weight-sparing effect
Insulin delivery using pens improves dosing accuracy, reduces hypoglycemia and is preferred by patients over vial/syringe
Insulin pens reduce needlestick injuries and dosing errors
Replacement of vial/syringe with insulin pens results in significant all-cause and hypoglycemia-related cost savings

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NPH-based to a glargine-based regimen (approximately 80% of whom used a basal-bolus regimen before and after the switch), HbA1c decreased by 0.31% after 1 year ($P < .001$) with no significant change in weight or total daily insulin dose.[51] These benefits can be maintained beyond 1 year, as demonstrated in a large 9-month observational study, with a 20-month extension period, in which glargine was added to the treatment regimen in 12,216 patients (mean age = 63.9 ± 11.3 years) inadequately controlled on OADs.[52] The addition of glargine significantly reduced HbA1c (by 1.5%) and fasting blood glucose (by 69 mg/dL) after 3 months, an improvement that was maintained at 9 months, and indeed at 20 months in 2721 patients who continued treatment during the extension. These benefits were achieved with no increase in body mass index. According to a comprehensive evaluation of basal insulin analogs, the addition of a once-daily long-acting insulin analog to OADs typically lowers HbA1c by about 1.5% over a period of 20 to 24 weeks, with reduced hypoglycemia at equivalent levels of glycemic control.[53] Data are fairly consistent for patients with baseline HbA1c of 8.5% or lower; for those with HbA1c in excess of this, a basal-only approach is probably insufficient to bring glycemic control to target, although, as previously explained, this may be less essential in the LTC setting.

Owing to the progressive nature of type 2 diabetes, many patients will ultimately need both basal and mealtime (prandial) insulin supplementation. This can be achieved simply in well-controlled patients with a consistent eating pattern by using once- or twice-daily premixed insulin; patients who are poorly controlled may be considered candidates for basal-bolus therapy.[4] Premixed insulin analogs offer similar HbA1c reduction to human premixes,[54,55] but by allowing flexible injection timing relative to meals, offer greater treatment flexibility, a particular advantage in the LTC population whose meal consumption is often inconsistent or whose meals may be delayed by factors beyond their control. When compared with long-acting insulins, premixed analogs offer significantly better postprandial control because of inclusion of the short-acting mealtime insulin component.[54] In the large PRESENT study, a multinational observational study of patients poorly controlled on human insulin ± OADs or OAD therapy alone, switching from biphasic human insulin to biphasic insulin aspart 70/30 significantly reduced mean HbA1c (–1.6%), FPG (–52.6 mg/dL), and PPG (–86.4 mg/dL).[56] The rate of overall, major, and nocturnal hypoglycemia fell from 8.9 to 2.2 episodes/patient year, 0.7 to 0.1 episodes/patient year, and 2.9 to 0.5 episodes/patient year, respectively. Premixed insulin analogs are available in prefilled pens, and allow for twice-daily injection.

Patients inadequately controlled on a premix may benefit from intensification of therapy using analog-based basal-bolus therapy. Study data indicate that a switch from a premix to an insulin glargine-based regimen, either in combination with OADs or as the basal component of a basal-bolus regimen, can improve glycemic control as well as tolerability and treatment satisfaction.[57,58] In a retrospective observational analysis of 345 patients with type 2 diabetes, of whom 48% were using premixed insulin only and 38% premixed insulin + OAD, a switch to insulin glargine ± OADs/prandial insulin decreased HbA1c by 0.53% after 12 months ($P < .001$) with no change in weight.[59] Not surprisingly, there was a significant increase in the number of patients who needed to add prandial insulin (from 16.2 % to 73.9%; $P < .001$) and an increase in total mean insulin administration ($P < .001$).

Candidates for basal-bolus therapy are best managed using rapid-acting analogs as the mealtime insulin. Although relevant clinical trials of basal-bolus therapy in type 2 diabetes are limited, a 26-week multinational study in 505 patients with type 2 diabetes (mean age = 60 years), randomized to either insulin detemir or NPH insulin, both with mealtime insulin aspart, found equivalent HbA1c levels at study end point, similar FPG reductions, and equivalent hypoglycemic risk.[60] However, detemir was associated with reduced intrasubject daily variation in fasting self-monitored blood glucose, and significantly less weight gain (1.0 versus 1.8 kg; $P = .02$). Similarly, a 22-week study of 395 individuals with type 2 diabetes found that an all-analog insulin regimen (insulin detemir plus insulin aspart) was associated with mean weight gain of 0.5 kg versus 1.1 kg in patients on an all-human insulin regimen (NPH insulin plus regular human insulin) ($P < .05$).[61]

In addition to the benefits of insulin analogs themselves, the delivery devices used for injection offer numerous advantages for patients and staff. Patients typically find insulin pens simple to use[62,63] and compared with syringe/vial, experience fewer hypoglycemic episodes[64] and express an overall preference,[65,66] resulting in greater adherence to treatment and improved quality of life. This is of particular value in subacute care patients who can be taught how to self-inject before returning home.

Economic Benefits of Insulin Analogs and Delivery Pens

By virtue of greater convenience and improved safety compared with vial and syringe,[67] insulin pens can reduce hypoglycemia rates, increase treatment satisfaction, and facilitate adherence, often at an overall cost saving.[66,68] The use of pens also reduces emergency visits and hospitalization.[64,66] For example, in one database analysis of managed-care claims for more than 40 million covered lives, adults with type 2 diabetes who switched from using vial/syringe to deliver human or analog insulin to using a prefilled insulin analog pen demonstrated significantly improved treatment adherence (increased from 62% to 69%; $P < .01$), reduced hypoglycemic risk (odds ratio [OR] = 0.5; 95% confidence interval [CI]: 0.37,0.68; $P < .05$), and significant reductions Q3 in emergency room and office visits ($P < .05$ for both).[66] This led to all-cause and hypoglycemia-attributable treatment savings of $1590 per patient ($P < .01$), and $788/patient ($P < .01$), respectively. In a second database study of 486 privately insured patients converting from human or analog insulin delivered by vial/syringe to an insulin analog pen, the incidence of hypoglycemia again decreased significantly (OR = 0.4; 95% CI: 0.27, 0.61; $P < .05$) as did

hypoglycemia-related emergency room and physician office visits ($P < .05$ for both); total annual and hypoglycemia-attributable treatment costs fell by $1748/patient and $908/patient, respectively.[64] There are also data suggesting that treatment costs can be reduced in Medicaid patients poorly controlled on OADs, by initiating an insulin analog pen rather than starting on vial/syringe when insulin becomes necessary.[69] In this large database analysis of Medicaid patients, total annualized health care costs were significantly lower in patients starting insulin using a pen as opposed to vial/syringe ($14,857 versus $31,765), as were hospital, diabetes-related, and outpatient costs ($P < .05$ for all).[69]

Improving the safety and accuracy of insulin delivery and blood glucose monitoring are important aspects of care. The Centers for Disease Control and Prevention (CDC) offer specific guidance on measures to reduce the risk of blood-borne transmission of pathogens during these procedures.[70] To this end, insulin pens, some used with dedicated needles that include safety features such as automatic safety locks (eg, NovoFine Autocover 8-mm needle [Novo Nordisk A/S, Bagsvaerd, Denmark], and the BD Autoshield Pen Needle [Becton Dickinson, Franklin Lakes, NJ]), can help address the relatively high rate of staff needlestick injuries resulting from use of disposable syringes (448 per 1000 nurses in one recent study),[71] and the associated risks and cost of viral hepatitis infection and missed days of work. The benefits of prefilled insulin pens include their use for delivery of premixed insulins, thereby avoiding mixing errors when withdrawing insulin from multiple vials, as well as the possibility of leaving them in a patient's personal medication drawer to avoid multiple user errors with vial/syringe, or selection of the wrong insulin; color coding may also help in selection of the appropriate pen and insulin. From an institutional perspective, the formulary simplification resulting from a complete switch from conventional insulins with vial and syringe, to insulin analogs and pens, can reduce the frequency and cost of dosing errors.[72]

CONCLUSIONS

Delivering high-quality care to LTC residents with diabetes requires an understanding of the unique needs of this population, and of the complexities involved in treating older individuals with multiple comorbidities in an institutional setting. There is a pressing need for more clinical trials that focus on elderly patients with diabetes, as well as improved treatment guidelines and algorithms for this population. Results of such research will help LTC health care providers manage diabetes in an evidence-based manner, as well as raising treatment expectations.

Although there are many challenges to delivering care, those that result from medication-related factors can often be met by switching from human to analog insulins, and by using insulin pens in selected patients. Insulin analogs generally provide more consistent glycemic control than human insulins, equivalent or improved HbA1c, better control of PPG and fasting glucose, and reduced rates of hypoglycemia, without the problem of weight gain. When used with insulin pens, which patients who self-inject generally prefer and find easy to use, these agents address several of the widely identified barriers to insulin use and facilitate treatment adherence. From an institutional perspective, these clinical benefits translate into economic advantages and significant cost savings over time. As the aging population of patients with diabetes increases in number, switching from human to analog insulins, and from vial/syringe to insulin pens, will provide clinical, safety, and economic benefits to both patients and LTC facilities.

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